

# **2021 IEEE International Smart Cities Conference (ISC2 2021)**

**Manchester, United Kingdom  
7 – 10 September 2021**



**IEEE Catalog Number: CFP21B42-POD  
ISBN: 978-1-6654-4920-5**

**Copyright © 2021 by the Institute of Electrical and Electronics Engineers, Inc.  
All Rights Reserved**

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

***\*\*\* This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP21B42-POD
ISBN (Print-On-Demand):	978-1-6654-4920-5
ISBN (Online):	978-1-6654-4919-9
ISSN:	2687-8852

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

# TABLE OF CONTENTS

ARE BERT EMBEDDINGS ABLE TO INFER TRAVEL PATTERNS FROM TWITTER EFFICIENTLY USING A UNIGRAM APPROACH?.....	1
<i>Francisco Murços, Tânia Fontes, Rosaldo J. F. Rossetti</i>	
DEEPFLOW: ABNORMAL TRAFFIC FLOW DETECTION USING SIAMESE NETWORKS .....	8
<i>Sepehr Sabour, Sanjeev Rao, Majid Ghaderi</i>	
AUGMENTED REALITY-ASSISTED HEALTHCARE SYSTEM FOR CAREGIVERS IN SMART REGIONS .....	15
<i>Joo Chan Kim, Saguna Saguna, Christer Åhlund, Karan Mitra</i>	
NEUROCAN: CONTEXTUAL ANOMALY DETECTION IN CONTROLLER AREA NETWORKS .....	22
<i>Prashanth Balaji, Majid Ghaderi</i>	
ADAPTIVE CONTROL FOR SMART WATER DISTRIBUTION SYSTEMS .....	29
<i>Mostafa Zaman, Maher Al Islam, Ashraf Tantawy, Carol J Fung, Sherif Abdelwahed</i>	
GRID-CITY: A FRAMEWORK TO SHARE SMART GRIDS COMMUNICATION WITH SMART CITY APPLICATIONS.....	35
<i>Giancarlo Covolo Heck, Roberto Hexsel, Victor B. Gomes, Luciana Iantorno, Lourival Lippmann Junior, Tiago Santana</i>	
MULTI-OBJECTIVE OPTIMIZATION OF INTEGRATED COMMUNITY ENERGY AND HARVESTING (ICE-HARVEST) SYSTEM BASED ON MARGINAL EMISSION FACTOR.....	39
<i>Alireza Lorestani, Jorge Chebeir, Mehdi Narimani, James S. Cotton</i>	
MODELING OF A UNIVERSITY CAMPUS MICRO-GRID FOR OPTIMAL PLANNING OF RENEWABLE GENERATION AND STORAGE DEPLOYMENT .....	46
<i>Marco Simonazzi, Nicola Delmonte, Paolo Cova, Gianluigi Ferrari, Francesco Zanichelli, Roberto Menozzi</i>	
A NEW METHODOLOGY FOR SMART CITIES IN DEVELOPING COUNTRIES: A CASE STUDY .....	53
<i>Lima Clarissa Loureiro, Cátia Muniz, Cleide Pereira, Luisa Paseto, Marcia Martinez, Angela Maria Alves</i>	
EFFICIENT HIGH-UTILITY ITEMSET MINING BASED ON A NOVEL DATA STRUCTURE .....	59
<i>Wei Shen, Chao Zhang, Wei Fang, Xin Zhang, Zhi-Hui Zhan, Jerry Chun-Wei Lin</i>	
A SCALABLE BLOCKCHAIN-BASED HIGH-DEFINITION MAP UPDATE MANAGEMENT SYSTEM.....	65
<i>Lei Zhong, Ryokichi Onishi, Ling Wang, Leifeng Ruan, Soo Jin Tan</i>	
A VISION-BASED FRAMEWORK FOR INTERSECTION MONITORING AND SIGNAL EVALUATION .....	69
<i>Mohammad Shokrolah Shirazi, Ahmad Patooghy</i>	
JANGSEUNG: A GUARDIAN FOR MACHINE LEARNING ALGORITHMS TO PROTECT AGAINST POISONING ATTACKS.....	73
<i>Shaya Wolf, Woodrow Gamboa, Mike Borowczak</i>	

INCLUSIVE MOBILITY SOLUTION FOR VISUALLY IMPAIRED PEOPLE USING GOOGLE CLOUD VISION.....	80
<i>Joana Gonçalves, Sara Paiva</i>	
VULNERABLE ROAD USERS SAFETY IN INFRASTRUCTURE ASSISTED INTELLIGENT TRANSPORTATION SYSTEM.....	87
<i>Vesh Raj Sharma Banjade, Satish Chandra Jha, Kathiravetpillai Sivanesan, Leonardo Gomes Baltar, Suman A Sehra, Soo Jin Tan</i>	
GAQ-EBKSP: A DRL-BASED URBAN TRAFFIC DYNAMIC REROUTING FRAMEWORK USING FOG-CLOUD ARCHITECTURE.....	94
<i>Runjia Du, Sikai Chen, Jiqian Dong, Paul Young Joun Ha, Samuel Labi</i>	
SMART CITY: APPLICATION OF MULTI-AGENT REINFORCEMENT LEARNING SYSTEMS IN ADAPTIVE TRAFFIC MANAGEMENT .....	101
<i>Kamilia Ahmadi, Vicki H Allan</i>	
REDESIGNING PATIENT FLOW IN PAEDIATRIC EYE CLINIC FOR PANDEMIC USING SIMULATION .....	108
<i>Kar Way Tan, Bee Keow Goh, Aldy Gunawan</i>	
KIGLIS: SMART NETWORKS FOR SMART CITIES .....	115
<i>Daniel Bogdoll, Patrick Matalla, Christoph Füllner, Christian Raack, Shi Li, Tobias Käfer, Stefan Orf, Marc René Zofka, Finn Sartoris, Christoph Schweikert, Thomas Pfeiffer, André Richter, Sebastian Randel, Rene Bonk</i>	
SENSING STREET-LEVEL CROWD DENSITY BY OBSERVING PUBLIC BLUETOOTH LOW ENERGY ADVERTISEMENTS FROM CONTACT TRACING APPLICATIONS .....	119
<i>Masahiro Bessho, Ken Sakamura</i>	
INCENTIVIZING TRUTHFULNESS IN CROWDSOURCED PARKING ECOSYSTEMS .....	126
<i>Anastasia-Maria Kamyli, Spyros Kontogiannis, Damianos Kypriadis, Christos Zaroliagis</i>	
EVALUATION OF A LOW-COST COTS BIO RADAR FOR VITAL SIGNS MONITORING .....	133
<i>Fábio Silva, Rita Almeida, Pedro Pinho, Paulo Marques, Sérgio Ivan Lopes</i>	
ENHANCED COMMUNICATION SUPPORT FOR APHASIA USING GESTURE RECOGNITION: THE BEDROOM SCENARIO .....	139
<i>Afonso Guimarães, Ana Patrícia Rocha, Luís Santana, Ilídio C. Oliveira, José Maria Fernandes, Samuel Silva, António Teixeira</i>	
BI-LEVEL PROGRAMMING FOR INTEGRATING FLEXIBLE DEMAND IN COMBINED SMART ENERGY SYSTEM .....	143
<i>Yufei Xi, Thomas Hamacher, Vedran Peric, Zhe Chen, Henrik Lund</i>	
AUTOMATIC QUANTIFICATION OF SETTLEMENT DAMAGE USING DEEP LEARNING OF SATELLITE IMAGES.....	149
<i>Lili Lu, Weisi Guo</i>	
TOWARDS PERSONALISED MENTAL WELLBEING RECOGNITION ON-DEVICE USING TRANSFER LEARNING “IN THE WILD” .....	155
<i>Kieran Woodward, Eiman Kanjo, David J. Brown, T. M. McGinnity</i>	
SMART GRID INTEGRATION INTO SMART CITIES .....	162
<i>Iman El-Dessouki, Nagham Saeed</i>	

SYSTEMATIC DESIGN OF BLOCKCHAIN BASED TESTBED FOR PEER - TO- PEER ENERGY TRADING.....	166
<i>Arpit Bajpai, Josef Schindler, Ralf Baun</i>	
THE DECOLONISATION OF THE SMART CITY THROUGH DEGROWTH AND SERENDIPITY .....	173
<i>Laura Temmerman, Wendy Van Den Broeck</i>	
CONCEPT OF INFRASTRUCTURE BASED ENVIRONMENT PERCEPTION FOR IN2LAB TEST FIELD FOR AUTOMATED DRIVING .....	177
<i>Shiva Agrawal, Gordon Elger</i>	
FEASIBILITY STUDY FOR DETECTING SHALLOW LANDSLIDES USING IOT DEVICES IN SMART CITIES.....	181
<i>Alessandro S. Santos, Alessandra C. Corsi, Rynaldo Z. H. Almeida, Mauro K. Noda, Ícaro Gonçalves, Rodrigo N. Ribeiro, Cezar O. Machado, Matheus Polkorny, Malena D'Elia Otero, Ana Elisa S. Abreu, Caio Azevedo, Mauro Spinola</i>	
SMART INFRASTRUCTURE: A RESEARCH JUNCTION.....	187
<i>Manuel Hetzel, Hannes Reichert, Konrad Doll, Bernhard Sick</i>	
TOWARDS SENSOR DATA ABSTRACTION OF AUTONOMOUS VEHICLE PERCEPTION SYSTEMS.....	191
<i>Hannes Reichert, Lukas Lang, Kevin Rösch, Daniel Bogdoll, Konrad Doll, Bernhard Sick, Hans-Christian Rellss, Christoph Stiller, J. Marius Zöllner</i>	
INTELI.GENTE PLATFORM: TOOL FOR DIAGNOSING MATURITY IN BRAZILIAN SUSTAINABLE SMART CITIES.....	195
<i>Luisa Paseto, José Gustavo Gontijo, Eliana Emediato De Azambuja, Karina Domingos Bressan Vidal, Angela Maria Alves, Cátia Regina Muniz, Cleide De Marco Pereira, Clarissa Fernanda C. L. Loureiro, Márcia Regina M. Martinez Corso</i>	
DRIVER GUIDANCE AND REBALANCING IN RIDE-HAILING SYSTEMS THROUGH MIXTURE DENSITY NETWORKS AND STOCHASTIC PROGRAMMING .....	201
<i>Xiaoming Li, Jie Gao, Chun Wang, Xiao Huang, Yimin Nie</i>	
A MATHEMATICAL MODEL TO EVALUATE VISUAL SENSING COVERAGE OF EMERGENCY SIGNS ON MOVING VEHICLES .....	208
<i>Daniel G. Costa, Francisco Vasques, Paulo Portugal</i>	
AN UNBIASED ESTIMATOR FOR HAMMING LSH BLOCKING.....	215
<i>Dimitrios Karapiperis, Aris Gkoulalas-Divanis</i>	
ONE CONVOLUTIONAL LAYER MODEL FOR PARKING OCCUPANCY DETECTION .....	219
<i>Soumia Goumiri, Dalila Benboudjema, Wojciech Pieczynski</i>	
SENSOR FUSION AND THE CITY: VISUALISATION AND AGGREGATION OF ENVIRONMENTAL & WELLBEING DATA .....	224
<i>Thomas Johnson, Eiman Kanjo</i>	
EVOLVING EXPERIENCES OF PARTICIPATION: TOWARDS AN E-ILAUD TOOL.....	228
<i>Pilar Maria Guerrieri, Sara Comai, Mariagrazia Fugini</i>	
USING USER DISSATISFACTION TO BRIDGE TRANSPORTATION GAP WITH SUPPLY- AND-DEMAND MEDIATION-TYPE SERVICE .....	235
<i>Tomoichi Ebata, Masashi Imamura, Kei Suzuki</i>	

NECESSITY OF AUTOMATED VULNERABILITY ASSESSMENT IN HEALTHCARE WITH THE EMERGENCE OF 5G .....	242
<i>Mahima Khushal, Waqar Asif</i>	
PERSONALIZED PRIVACY PRESERVATION FOR SMART GRID .....	248
<i>Arpan Bhattacharjee, Shahriar Badsha, Shamik Sengupta</i>	
PROGNOSTICS AND MANAGEMENT OF MENTAL STRESS BY AIOT MONITORING AND SCHLEGEL DIAGRAMS .....	255
<i>Alberto Faro, Daniela Giordano</i>	
EDGE COMPUTING-ENABLED CROWD DENSITY ESTIMATION BASED ON LIGHTWEIGHT CONVOLUTIONAL NEURAL NETWORK .....	262
<i>Shuo Wang, Ziyuan Pu, Qianmu Li, Yaming Guo, Meng Li</i>	
WA/ONDERING WITH DATA - OR, RESPONSIBLY MEASURING SOCIO-TECHNICAL SERENDIPITY IN THE URBAN ENVIRONMENT .....	269
<i>Sabrina Sauer, Samantha Copeland</i>	
TRIP DISTRIBUTION PATTERNS ON A UNIVERSITY CAMPUS: A SMARTER TRAVEL DEMAND FORECASTING APPROACH.....	273
<i>Matthew Vechione, Sohil Paudel, Okan Gurbuz</i>	
A MACROCAUSE CLASSIFICATION MODEL FOR VIOLENT CRIME ANALYSIS IN THE FIELD OF PUBLIC SAFETY BASED ON MACHINE LEARNING TECHNIQUES .....	280
<i>Ramiro D. V. Dos Santos Junior, João Vitor Venceslau Coelho, Nelio Alessandro Azevedo Cacho</i>	
URBAN EMERGENCY MANAGEMENT USING INTELLIGENT TRAFFIC SYSTEMS: CHALLENGES AND FUTURE DIRECTIONS .....	287
<i>Fatemeh Golpayegani, Saeedeh Ghanadbashi, Maha Riad</i>	
CROWDTRACING: OVERCROWDING CLUSTERING AND DETECTION SYSTEM FOR SOCIAL DISTANCING .....	291
<i>Eiman Kanjo, Dario Ortega Anderez, Amna Anwar, Ahmad Al Shami, James Williams</i>	
IMPACT OF COVID-19 ON MOBILITY AND TRAFFIC VOLUME TRENDS IN MONTANA AND CALIFORNIA .....	298
<i>Nada Abdelfattah, Maryam Bahramipanah</i>	
INFECTION AND RE-INFECTION: STABILITY OF COMPLEX AIR TRANSPORT NETWORK.....	304
<i>Mengbang Zou, Weisi Guo</i>	
MAXIMAL NETWORK LIFETIME SCHEDULING ALGORITHMS FOR ROADSIDE SENSOR NETWORKS.....	308
<i>Xili Wan, Tingxiang Ji, Xinjie Guan, Feng Ye, Yifeng Li</i>	
ANALYSIS OF ACTIVITIES BASED ON A SINGLE-SHOE EQUIPPED WITH FORCE SENSORS .....	315
<i>Kaleb Key, Spencer Mason, Billy Kihei</i>	
5G ENABLED REALTIME HEALTHCARE SYSTEM FOR HEART PATIENTS.....	322
<i>Hafiz Husnain Raza Sherazi, Waqar Asif, Zohaib Ashfaq Khan</i>	

COALITION GAME APPROACH FOR ELECTRICITY SHARING IN MULTI-ENERGY MULTI-MICROGRID NETWORK .....	328
<i>Xiaoqing Zhong, Weifeng Zhong, Yi Liu, Chao Yang, Shengli Xie</i>	
CAPACITY AND ENERGY LOCAL FLEXIBILITY MARKETS FOR IMBALANCE AND CONGESTION MANAGEMENT .....	334
<i>Angel Paredes, José A. Aguado</i>	
DEVELOPING SMART CITY IN THE NEW CAPITAL OF INDONESIA .....	341
<i>Rini Rachmawati, Eko Haryono, Amandita Ainur Rohmah</i>	
ONE-TO-MULTIPLE MOBILE REPLENISHMENT PATH PLANNING WITH OVERCHARGING AWARENESS .....	348
<i>Xinjie Guan, Hao Zhang, Xili Wan, Guangwei Bai, Feng Ye</i>	
CYCLIST TRAJECTORY FORECASTS BY INCORPORATION OF MULTI-VIEW VIDEO INFORMATION .....	355
<i>Stefan Zernetsch, Oliver Trupp, Viktor Kress, Konrad Doll, Bernhard Sick</i>	
OPTIMIZED ROUTING FOR PEOPLE WITH PERMANENT OR TEMPORARY MOBILITY DISABILITY: A CASE STUDY IN VIANA DO CASTELO .....	362
<i>David Verde, Tânia Silva, Ana I. Pereira, Sara Paiva</i>	
TRAVELING SALESMAN PROBLEM ON SMART METER INFRASTRUCTURE .....	368
<i>Shimpei Ohsugi, So Negishi, Kensaku Okada, Hayato Yoshii, Kenji Tanaka, Noboru Koshizuka</i>	
VISION-BASED CROWD COUNTING AND SOCIAL DISTANCING MONITORING USING TINY-YOLOV4 AND DEEPSORT .....	375
<i>Immanuel Jose C. Valencia, Elmer P. Dadios, Alexis M. Fillone, John Carlo V. Puno, Renann G. Baldovino, Robert Kerwin C. Billones</i>	
ASSESSING THE IMPACT OF MAJOR HISTORICAL EVENTS ON URBAN LANDSCAPES VIA LOCAL ENTROPY MEASURES .....	382
<i>Matteo Mazzamurro, Weisi Guo</i>	
SUPPLY TEMPERATURE CONTROL OF A HEATING NETWORK WITH REINFORCEMENT LEARNING .....	389
<i>Sara Ghane, Stef Jacobs, Wim Casteels, Christian Brembilla, Siegfried Mercelis, Steven Latré, Ivan Verhaert, Peter Hellinckx</i>	
SHORT-TERM FORECASTING FOR UTILIZATION RATES OF ELECTRIC VEHICLE CHARGING STATIONS .....	396
<i>Zuzhao Ye, Ran Wei, Nanpeng Yu</i>	
QCCF-TREE: A NEW EFFICIENT IOT BIG DATA INDEXING METHOD AT THE FOG- CLOUD COMPUTING LEVEL .....	403
<i>Karima Khettabi, Zineddine Kouahla, Brahim Farou, Hamid Seridi</i>	
OPENCITY: AN OPEN ARCHITECTURE TESTBED FOR SMART CITIES .....	410
<i>Nasibeh Zohrabi, Patrick J. Martin, Murat Kuzlu, Lauren Linkous, Roja Eini, Adam Morrissett, Mostafa Zaman, Ashraf Tantawy, Oezguer Gueler, Maher Al Islam, Nathan Puryear, Halil Kalkavan, Jonathan Lundquist, Erwin Karincic, Sherif Abdelwahed</i>	
MOSAIC: MODELING SAFETY INDEX IN CROWD BY DETECTING FACE MASKS AGAINST COVID-19 AND BEYOND .....	417
<i>Khalid J Almaliki, Muhammad Mohzary, Baek-Young Choi, Sejun Song, Yu Chen</i>	

A RESOURCE-BASED MODEL FOR HOME ENERGY MANAGEMENT USING MULTI-AGENT SYSTEMS .....	424
<i>Sofia Martins, Rosaldo J. F. Rossetti, Zafeiris Kokkinogenis</i>	
ANALYSING PUBLIC SENTIMENTS REGARDING COVID-19 VACCINES: A SENTIMENT ANALYSIS APPROACH.....	428
<i>Arslan Amjad, Shahzad Qaiser, Aamir Anwar, Ijaz-Ul-Haq, Ramsha Ali</i>	
IMPROVED PRIVACY-ENSURING DATA-FUSION AND SERVICE RECOMMENDATION FOR USERS IN SMART CITIES.....	435
<i>Mohd. Sarim, Mohammad Samar Ansari, Nadia Kanwal, Mamoona Asghar</i>	
SMART PARKING: NOVEL FRAMEWORK OF SECURE SMART PARKING SOLUTION USING 5G TECHNOLOGY .....	442
<i>Aamir Anwar, Ijaz-Ul-Haq, Nagham Saeed, Parisa Saadati</i>	
LOAD BALANCING AND RESOURCE ALLOCATION IN SMART CITIES USING REINFORCEMENT LEARNING .....	446
<i>Aseel Alorbani, Michael Bauer</i>	
A MULTI-CRITERIA MULTI-MODAL PREDICTIVE TRIP PLANNER: APPLICATION ON PARIS METROPOLITAN NETWORK.....	453
<i>Pascal Benchimol, Ahmed Amrani, Mostepha Khouadjia</i>	
TOWARDS A REAL-TIME SYSTEM BASED ON REGRESSION MODEL TO EVALUATE DRIVER'S ATTENTION.....	457
<i>Thiago K. Lago, Ernesto Rodríguez González, Miguel Elias M. Campista</i>	
PRICE CONTROL-BASED DECENTRALIZED ELECTRIC VEHICLE CHARGING COORDINATION BY ARBITRATION TYPE AGGREGATORS FOR SMART BUILDINGS.....	464
<i>Seungwook Yoon, Euiseok Hwang</i>	
ADAPTIVE PARKING SLOT OCCUPANCY DETECTION USING VISION TRANSFORMER AND LLIE.....	468
<i>Karthick Pannerselvam</i>	
WALKSHOPS FOR CITIZEN INVOLVEMENT: WALK THE TALK WITH SMART CITY CITIZENS .....	475
<i>Ine Van Zeeland, Jonas Breuer, Jo Pierson</i>	
3D PRIVACY FRAMEWORK: THE CITIZEN VALUE DRIVEN PRIVACY FRAMEWORK.....	479
<i>Edgard Musafiri Mimo, Troy McDaniel</i>	
BOTTLENECK ANALYSIS IN JFK USING DISCRETE EVENT SIMULATION: AN AIRPORT QUEUING MODEL.....	486
<i>Joseph Lai, Leslie Che, Rasha Kashef</i>	
SMART CITY DATA MODELLING USING SEMANTIC WEB TECHNOLOGIES .....	493
<i>Devis Bianchini, Valeria De Antonellis, Massimiliano Garda, Michele Melchiori</i>	
IOT-BASED DYNAMIC MAP ATTRIBUTES FOR CONNECTED AND AUTONOMOUS VEHICLES.....	500
<i>Mohamed Mounir Moussa, Lubna Alazzawi</i>	
EVALUATING THE PERFORMANCE OF VARIOUS ACOPF FORMULATIONS USING NONLINEAR INTERIOR-POINT METHOD .....	506
<i>Sayed Abdullah Sadat</i>	



SERVICE-AWARE 5G/B5G CELLULAR NETWORKS FOR FUTURE CONNECTED VEHICLES.....	513
<i>Ping Du, Akihiro Nakao, Lei Zhong, Jing Ma, Ryokichi Onishi</i>	

CREATING RESILIENCE FOR CLIMATE CHANGE IN SMART CITIES BASED ON THE LOCAL FOOD SUPPLY CHAIN .....	517
<i>Mario E. Vallejo, Victor M. Larios, Verónica Gutiérrez Magallanes, Cecilia Cobián, María De La Luz Guzmán Castañeda, Guillermo Balandrán Téllez</i>	

**Author Index**